

AMENDMENTS TO THE CLAIMS

1. (currently amended): A method of automatically re-provisioning a network element in adaptation to a failure, the method comprising the computer-implemented steps of:
identifying a network element that has failed;
a cluster manager selecting a substitute network element from among a pool of one or more available network elements to replace the specific network element identified as failing;
the cluster manager receiving connection configuration information from the identified specific network element identified as failing; [[and]]
wherein the cluster manager is communicatively coupled to a cluster comprising a plurality of active network elements, the pool of one or more available network elements, a first network switch, and a second network switch;
based on the connection configuration information, the cluster manager re-
configuring the substitute network element and one or more switch devices associated with the identified network element, wherein the re-configuring causes the one or more switch devices to change one or more connections from the identified network element to the substitute network element;
~~wherein the steps are performed by a cluster manager that is communicatively coupled to a cluster comprising a plurality of active network elements, the pool of one or more available network elements, a first network switch, and a second network switch~~
the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;

wherein a connection object comprises a programmatic object that points to a fixed defined set of templates and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations; and
the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.

2. (currently amended) The method as recited in Claim 1, wherein the specific identified network element identified as failing is one of a plurality of network elements in [[a]] the cluster that is associated with the first and second network switches.
3. (cancelled)
4. (previously presented) The method as recited in Claim 1, wherein the step of re-configuring comprises the steps of sending a trigger event to the substitute network element that causes the substitute network element to retrieve a configuration over a network connection.
5. (previously presented) The method as recited in Claim 1, wherein re-configuring comprises dynamically reconfiguring the selected network element as a logical clone of the identified network element.
6. (previously presented) The method as recited in Claim 1, further comprising the step of associating the identified network element with the pool of available network elements.
7. (previously presented) The method as recited in Claim 1, further comprising the steps of:
sending an initial configuration to the substitute network element;

sending a partial accumulated configuration to the substitute network element; and
sending instructions that cause the identified network element to reboot based on a
configuration setting of a cluster associated with the identified network
element.

8. (previously presented) The method as recited in Claim 1, further comprising the steps of:

receiving first user input in a graphical user interface that associates the network
elements in a cluster with a first switch and a second switch;
receiving second user input that specifies which network elements are reserved in the
pool of available network elements.

9. (previously presented) The method as recited in Claim 1, wherein each of the network
elements is a network aggregation device or a network access server.

10. (previously presented) The method as recited in Claim 1, further comprising repeating
the steps for multiple concurrently failed network elements.

11. (previously presented) The method as recited in Claim 1, further comprising the steps of:

receiving a message specifying a failure of a network element over an event bus on
which the network elements publish events and on which a cluster manager
subscribes to events;

based on the message, identifying the network element that has failed.

12. (previously presented) The method as recited in Claim 1, wherein the network
switches are asynchronous transfer mode (ATM) switches, and wherein the network
elements are routers in a packet-switched network.

13. (currently amended) A method of automatically re-provisioning a network element in adaptation to a failure, the method comprising the computer-implemented steps of:
- receiving first user input that defines a cluster comprising a first network switch, a plurality of network elements, and a second network switch;
- receiving second user input that specifies one or more of the network elements as a pool of available network elements;
- identifying a network element that has failed;
- selecting a substitute network element from among the pool; and
- re-configuring the first network switch and the second network switch, wherein the re-configuring causes the first network switch and second network switch to change one or more connections from the identified network element to the substitute network element
- wherein the steps are performed by a cluster manager that is communicatively coupled to a cluster comprising a plurality of active network elements, the pool of one or more available network elements, the first network switch, and the second network switch;
- the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;
- wherein a connection object comprises a programmatic object that points to a fixed defined set of templates and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations;
- and
- the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the substitute

network elements selected from the pool of available substitute network elements.

14. (previously presented) The method as recited in Claim 13, wherein the step of re-configuring comprises the steps of sending a trigger event to the substitute network element that causes the substitute network element to retrieve a configuration over a network connection.
15. (previously presented) The method as recited in Claim 13, wherein re-configuring comprises dynamically reconfiguring the selected network element as a logical clone of the identified network element.
16. (previously presented) The method as recited in Claim 13, further comprising the step of associating the identified network element with the pool of available network elements.
17. (previously presented) The method as recited in Claim 13, further comprising the steps of:

sending an initial configuration to the substitute network element;

sending a partial accumulated configuration to the substitute network element; and

sending instructions that cause the identified network element to reboot based on a

configuration setting of a cluster associated with the identified network element.
18. (previously presented) The method as recited in Claim 13, wherein each of the network elements is a network aggregation device or a network access server.
19. (previously presented) The method as recited in Claim 13, further comprising repeating the steps for multiple concurrently failed network elements.

20. (previously presented) The method as recited in Claim 13, further comprising the steps of:
- receiving a message specifying a failure of a network element over an event bus on which the network elements publish events and on which a cluster manager subscribes to events;
- based on the message, identifying the network element that has failed.
21. (previously presented) The method as recited in Claim 13, wherein the network switches are asynchronous transfer mode (ATM) switches, and wherein the network elements are routers in a packet-switched network.
22. (currently amended) A computer-readable medium storing one or more sequences of instructions for automatically re-provisioning a network element in adaptation to a failure, which instructions, when executed by one or more processors, cause the one or more processors to carry out the steps of:
- identifying a network element that has failed;
- a cluster manager selecting a substitute network element from among a pool of one or more available network elements to replace the specific network element identified as failing;
- the cluster manager receiving connection configuration information from the identified specific network element identified as failing; [[and]]
- wherein the cluster manager is communicatively coupled to a cluster comprising a plurality of active network elements, the pool of one or more available network elements, a first network switch, and a second network switch;
- based on the connection configuration information, the cluster manager re-configuring the substitute network element and one or more switch devices

associated with the identified network element, wherein the re-configuring causes the one or more switch devices to change one or more connections from the identified network element to the substitute network element; ~~wherein the steps are performed by a cluster manager that is communicatively coupled to a cluster comprising a plurality of active network elements, the pool of one or more available network elements, a first network switch, and a second network switch~~

the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;

wherein a connection object comprises a programmatic object that points to a fixed defined set of templates intended to be applied to a stack device and adjacent switches, and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations; and
the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.

23. (previously presented) The computer-readable medium as recited in Claim 22, wherein the identified network element is one of a plurality of network elements in a cluster that is associated with first and second network switches.
24. (cancelled)
25. (previously presented) The computer-readable medium as recited in Claim 22, wherein the instructions for re-configuring further comprise instructions for sending a trigger event to the substitute network element that causes the substitute network element to retrieve a configuration over a network connection.

26. (previously presented) The computer-readable medium as recited in Claim 22, wherein the instructions for re-configuring further comprise instructions for dynamically reconfiguring the selected network element as a logical clone of the identified network element.
27. (previously presented) The computer-readable medium as recited in Claim 22, further comprising instructions for associating the identified network element with the pool of available network elements.
28. (previously presented) The computer-readable medium as recited in Claim 22, further comprising instructions for:
 - sending an initial configuration to the substitute network element;
 - sending a partial accumulated configuration to the substitute network element; and
 - sending instructions that cause the identified network element to reboot based on a configuration setting of a cluster associated with the identified network element.
29. (previously presented) The computer-readable medium as recited in Claim 22, further comprising instructions for:
 - receiving first user input in a graphical user interface that associates the network elements in a cluster with a first switch and a second switch;
 - receiving second user input that specifies which network elements are reserved in the pool of available network elements.
30. (previously presented) The computer-readable medium as recited in Claim 22, wherein each of the network elements is a network aggregation device or a network access server.

31. (previously presented) The computer-readable medium as recited in Claim 22, further comprising instructions for repeatedly executing the instructions for multiple concurrently failed network elements.
32. (previously presented) The computer-readable medium as recited in Claim 22, further comprising instructions for performing the steps of:
receiving a message specifying a failure of a network element over an event bus on
which the network elements publish events and on which a cluster manager
subscribes to events;
based on the message, identifying the network element that has failed.
33. (previously presented) The computer-readable medium as recited in Claim 22,
wherein the network switches are asynchronous transfer mode (ATM) switches, and
wherein the network elements are routers in a packet-switched network.
34. (currently amended) An apparatus for automatically re-provisioning a network
element in adaptation to a failure, comprising:
means for identifying a network element that has failed;
means for selecting a substitute network element from among a pool of one or more
available network elements to replace the specific network element identified
as failing;
means for receiving connection configuration information from the ~~identified~~ specific
network element identified as failing; and
means for re-configuring the substitute network element and one or more switch
devices associated with the identified network element, based on the
connection configuration information, wherein the re-configuring causes the

one or more switch devices to change one or more connections from the identified network element to the substitute network element; and a cluster manager that is communicatively coupled to a cluster comprising the failed and substitute network elements and the one or more switch devices; the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network; wherein a connection object comprises a programmatic object that points to a fixed defined set of templates intended to be applied to a stack device and adjacent switches, and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations; and the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.

35. (previously presented) The apparatus as recited in Claim 34, wherein the identified network element is one of a plurality of network elements in a cluster that is associated with first and second network switches.
36. (cancelled)
37. (previously presented) The apparatus as recited in Claim 34, wherein the re-configuring means comprises means for sending a trigger event to the substitute network element that causes the substitute network element to retrieve a configuration over a network connection.
38. (previously presented) The apparatus as recited in Claim 34, wherein the re-configuring means comprises means for dynamically reconfiguring the selected network element as a logical clone of the identified network element.

39. (previously presented) The apparatus as recited in Claim 34, further comprising means for associating the identified network element with the pool of available network elements.
40. (previously presented) The apparatus as recited in Claim 34, further comprising: means for sending an initial configuration to the substitute network element; means for sending a partial accumulated configuration to the substitute network element; and means for sending instructions that cause the identified network element to reboot based on a configuration setting of a cluster associated with the identified network element.
41. (previously presented) The apparatus as recited in Claim 34, further comprising: means for receiving first user input in a graphical user interface that associates the network elements in a cluster with a first switch and a second switch; means for receiving second user input that specifies which network elements are reserved in the pool of available network elements.
42. (previously presented) The apparatus as recited in Claim 34, wherein each of the network elements is a network aggregation device or a network access server.
43. (previously presented) The apparatus as recited in Claim 34, further comprising means for using the other means repeatedly for multiple concurrently failed network elements.
44. (previously presented) The apparatus as recited in Claim 34, further comprising: means for receiving a message specifying a failure of a network element over an event bus on which the network elements publish events and on which a cluster manager subscribes to events;

means for identifying the network element that has failed, based on the message.

45. (previously presented) The apparatus as recited in Claim 34, wherein the network switches are asynchronous transfer mode (ATM) switches, and wherein the network elements are routers in a packet-switched network.

46. (currently amended) An apparatus for automatically re-provisioning a network element in adaptation to a failure, comprising:

a network interface that is coupled to the data network for receiving one or more packet flows therefrom;

a processor;

one or more stored sequences of instructions which, when executed by the processor, cause the processor to carry out the steps of:

identifying a network element that has failed;

a cluster manager selecting a substitute network element from among a pool of one or more available network elements to replace the specific network element

identified as failing;

the cluster manager receiving connection configuration information from the

~~identified~~ specific network element identified as failing; and

based on the connection configuration information, the cluster manager re-

configuring the substitute network element and one or more switch devices associated with the identified network element, wherein the re-configuring causes the one or more switch devices to change one or more connections from the identified network element to the substitute network element;

~~wherein the steps are performed by a cluster manager that is communicatively coupled to a cluster comprising the failed and substitute network elements and the one or more switch devices~~

the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;

wherein a connection object comprises a programmatic object that points to a fixed defined set of templates intended to be applied to a stack device and adjacent switches, and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations; and
the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.

47. (currently amended) The method as recited in Claim 1, wherein the specific identified network element identified as failing is one of a plurality of network elements in ~~[[a]]~~ the cluster that is associated with the first and second network switches.
48. (cancelled)
49. (previously presented) The apparatus as recited in Claim 46, wherein the step of re-configuring comprises the steps of sending a trigger event to the substitute network element that causes the substitute network element to retrieve a configuration over a network connection.
50. (previously presented) The apparatus as recited in Claim 46, wherein re-configuring comprises dynamically reconfiguring the selected network element as a logical clone of the identified network element.

51. (previously presented) The apparatus as recited in Claim 46, further comprising the step of associating the identified network element with the pool of available network elements.
52. (previously presented) The apparatus as recited in Claim 46, further comprising the steps of:
 - sending an initial configuration to the substitute network element;
 - sending a partial accumulated configuration to the substitute network element; and
 - sending instructions that cause the identified network element to reboot based on a configuration setting of a cluster associated with the identified network element.
53. (previously presented) The apparatus as recited in Claim 46, further comprising the steps of:
 - receiving first user input in a graphical user interface that associates the network elements in a cluster with a first switch and a second switch;
 - receiving second user input that specifies which network elements are reserved in the pool of available network elements.
54. (previously presented) The apparatus as recited in Claim 46, wherein each of the network elements is a network aggregation device or a network access server.
55. (previously presented) The apparatus as recited in Claim 46, further comprising repeating the steps for multiple concurrently failed network elements.
56. (previously presented) The apparatus as recited in Claim 46, further comprising the steps of:

- receiving a message specifying a failure of a network element over an event bus on which the network elements publish events and on which a cluster manager subscribes to events;
- based on the message, identifying the network element that has failed.
57. (previously presented) The apparatus as recited in Claim 46, wherein the network switches are asynchronous transfer mode (ATM) switches, and wherein the network elements are routers in a packet-switched network.
- 58-60. (cancelled)
61. (previously presented) The method as recited in Claim 1, further comprising:
a switch adjacent to a failing node sending an event on an event bus indicating that an interface on a failing switch is no longer active.
62. (previously presented) The method as recited in Claim 61, further comprising:
the cluster manager receiving notification of the event and identifying a node that has failed.
63. (currently amended) The method as recited in Claim [[63]] 62, further comprising:
the cluster manager correlating an interface on the failing ~~switch~~ node to a specific stack element.
64. (currently amended) The method as recited in Claim 1, further comprising:
the cluster manager using a keepalive or heartbeat protocol ~~against~~ to determine the status of a plurality of stack elements.
65. (previously presented) The method as recited in Claim 1, further comprising:
the cluster manager searching for a device in the free pool that is available for use as a fail-over device.

66. (currently amended) A method of automatically re-provisioning a network element in adaptation to a failure, the method comprising the computer-implemented steps of:
- a cluster manager identifying a network element that has failed;
 - the cluster manager selecting a substitute network element from among a pool of one or more available network elements to replace the specific network element identified as failing;
 - the cluster manager receiving connection configuration information from the ~~identified~~ specific network element identified as failing; and
- based on the connection configuration information, the cluster manager re-configuring the substitute network element and one or more switch devices associated with the identified network element, wherein the re-configuring causes the one or more switch devices to change one or more connections from the identified network element to the substitute network element;
- wherein the step of re-configuring comprises the steps of sending a trigger event to the substitute network element that causes the substitute network element to retrieve ~~[[a]]~~ configuration information over a network connection;
- the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;
- wherein a connection object comprises a programmatic object that points to a fixed defined set of templates and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations;
- and

the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.

67. (currently amended) A method of automatically re-provisioning a network element in adaptation to a failure, the method comprising the computer-implemented steps of:

a cluster manager identifying a network element that has failed;

the cluster manager selecting a substitute network element from among a pool of one or more available network elements to replace the specific network element identified as failing;

the cluster manager receiving connection configuration information from the identified specific network element identified as failing; and

based on the connection configuration information, the cluster manager re-configuring the substitute network element and one or more switch devices associated with the identified network element, wherein the re-configuring causes the one or more switch devices to change one or more connections from the identified network element to the substitute network element;

wherein re-configuring comprises dynamically reconfiguring the selected network element as a logical clone of the identified network element;

the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;

wherein a connection object comprises a programmatic object that points to a fixed defined set of templates intended to be applied to a cluster, and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations; and

when failover occurs, the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.

68. (currently amended) A method of automatically re-provisioning a network element in adaptation to a failure, the method comprising the computer-implemented steps of:
a cluster manager identifying a network element that has failed;
the cluster manager selecting a substitute network element from among a pool of one or more available network elements to replace the specific network element identified as failing;
the cluster manager receiving connection configuration information from the ~~identified~~ specific network element identified as failing; and
based on the connection configuration information, re-configuring the substitute network element and one or more switch devices associated with the identified network element, wherein the re-configuring causes the one or more switch devices to change one or more connections from the identified network element to the substitute network element;
sending an initial configuration to the substitute network element;
sending a partial accumulated configuration to the substitute network element; and
sending instructions that cause the identified network element to reboot based on a configuration setting of a cluster associated with the identified network element;
the cluster manager managing a plurality of connection objects corresponding to the number of subscribers in the network;

wherein a connection object comprises a programmatic object that points to a fixed defined set of templates and contains attributes providing specific substitution values to be used when instantiating the templates into actual configurations; and the cluster manager logically re-associating all of the plurality of connection objects of the specific network element identified as failing with the new network element selected from the pool of available substitute network elements.